

his mind whether he is content to leave these questions as he finds them, or is impelled to adapt them to some more or less plausible metaphysical solution. Dr. Croll, whose death we have so recently had occasion to lament, made his mark by a skilful application of physical reasoning to sundry difficult problems connected with climate and time. It need hardly be said that the whole tendency of his thought and work was in support of the doctrine of evolution in its widest sense. In the volume before us he discusses, after forty years of meditation, the fundamental principles which underlie this doctrine.

At the outset, Dr. Croll draws and emphasizes what he terms "the radical and essential distinction between force and the determination of force." The *production* of motion, he says, is one thing; the *determination* of its direction, another and perfectly distinct thing. When a molecule is to be moved, there is an infinite number of directions in which force may be conceived to move it. But, out of the infinite number of different paths, what is it that directs the force to select the right path? Force produces motion, but what determines it and gives it its thusness? "In the formation of, say, the leaf of a tree, no two molecules move in identically the same path. But each molecule must move in relation to the objective idea of the leaf, or no leaf would be formed. The grand question therefore is, What is it that selects from among the infinite number of possible directions the proper one in relation to this idea?"

Dr. Croll states in his preface that his volume is not of a speculative or hypothetical nature. But we venture to think that, notwithstanding this disclaimer, the "objective idea" of a leaf comes perilously near a metaphysical as opposed to a scientific conception. But let that pass. We venture to think, further, that physicists may be a little impatient with the "radical and essential distinction between force and the determination of force." This, too, they may be disposed to regard as rather a metaphysical than a physical distinction. And this the more, since physicists are accused of attributing everything to force, and little or nothing to the far more important determination of force. Let us, however, endeavour to see what Dr. Croll's contention really amounts to. And let us take the simpler case of a crystal of alum, instead of the more complex case of a leaf, involving, as this latter does, complicating elements such as heredity and natural selection.

From a solution of potassium aluminium sulphate, octohedral crystals of alum are obtained on evaporation. Concerning them, Dr. Croll says, in effect: Granted that the molecules run into crystalline figure under the stress of certain forces, *why this particular figure?* Force accounts for their motion, but what determines the direction of motion so as to give rise to this particular form and not a scalenohedron or a rhombic pyramid? Many of us are content, at this point, to confess our ignorance, and to say that it is a way they have; it is part of the constitution of Nature as presented for our study. But possibly, others may descend to more recondite physical principles. Let us, then, for the nonce, grant that if we only knew the full bearings of that fundamental physical principle, that force is the product of mass into acceleration, we should find the crystalline figure of the alum in-

evitably contained therein. Few, if any, are likely to go so far. But if such there be, even of them Dr. Croll will still ask: What, then, has determined that force should be the product of mass into acceleration, rather than the product of mass into momentum, or an indefinite number of other conceivabilities? If it be replied that such is the constitution of things, the answering question will still be, But what determined that the world should be so constituted?

It will now be seen that Dr. Croll's question, though couched in new terms, is an old, old question. Nor are the solutions suggested other than those which have of old been put forward. And if Dr. Croll adopts a Theistic solution, he does not adduce other than the well-worn arguments, which it is not our province to discuss.

Two chapters are devoted to "Determinism in relation to Spencerianism," in which Dr. Croll inquires whether a rational explanation of evolution can be derived from the persistence of force. The conclusion arrived at is that no such rational explanation can be deduced from this vaguely definite axiom; and in this we are disposed to agree. With all our admiration of Mr. Herbert Spencer's power as a thinker, we believe that a synthetic philosophy, *quâ* synthetic, is of little, if any, practical or speculative value. If the synthesis leads us back to the universe from which our analysis started, nothing is gained thereby; if it brings us to a different universe, we can afford to neglect it. Other chapters are devoted to "Determinism in relation to Darwinism," in which Dr. Croll points out that natural selection does not and cannot explain the origin of variations; but this, though true enough, is an old story.

Some of the ablest sections of the work, including an appendix of three chapters, are devoted to "Determinism in relation to Free-will." We fancy that some of those who may welcome Dr. Croll's argument for Theism will be unwilling to accept his argument for determinism in the matter of human conduct. They will, however, find his discussion of the matter well worthy of careful consideration, as, indeed, are many other parts of the little treatise.

In conclusion, we must state that we have felt some diffidence in dealing with this work of an author who has so recently passed beyond the reach of either praise or criticism. We could not, however, pass it by in silence; and since we were impelled to speak, we have not hesitated to speak frankly; and we trust that Dr. Croll's many friends will not blame us for the course we have adopted. C. LL. M.

NATURAL HISTORY OF THE ANIMAL KINGDOM.

Natural History of the Animal Kingdom, for the Use of Young People. In Three Parts. With 91 Coloured Plates and numerous additional Illustrations in the Text. Adapted from the German of Prof. von Schubert by W. F. Kirby. (London: The Society for Promoting Christian Knowledge, 1889.)

THE number of books on natural history, written for the purpose of attracting persons young in years or knowledge is truly astonishing; in most cases they are

adaptations from French or German sources, but sometimes they are "original" compilations. They are always illustrated; they come, and, what is more truly wonderful, they go, in the trade acceptance of this word. The demand for them would seem to be great—so great that few are able to resist the temptation of adding to their number, not knowing beforehand what pains of remorse are caused to the authors of such writings, in after days.

Times there were when, in the infancy of knowledge, such books as Patterson's "Zoology for Schools" and Milne Edwards's "Elementary Course of Natural History" served a useful purpose and had their day; but the rapid piling up of additions to that knowledge soon left it impossible for any single person to keep up with it, and even to write a good popular treatise on one small group of animals required the combined labour of a Kirby and a Spence. However, when the demand went on as before, the hint conveyed by such a fact was quite wasted, and the publishers took steps to meet it. Natural history for the people is now in as great favour as ever, and it must be brought out in a manner not only to attract the crowd, but it must be within their pecuniary resources. From some experience we have learned that works of the popular natural history class are not written with the view of being criticized; indeed, it would appear to be scarcely fair to subject them to any such ordeal, at least from a scientific point of view. A compiler who had a good working knowledge of, say, the mammals and birds, would be a more or less exceptional creature; if he knew something of the whole group of the Vertebrates, he would be far out of the common; but even such a one would flounder when he came to treat of the remaining great groups; we laugh at Oliver Goldsmith's "Animated Nature," but a learned entomologist might be as ignorant of the Vertebrates and the Mollusca as Goldsmith was of the difference between a cow and a horse. Therefore instead of criticism, we venture to think that commiseration were the more needed, and perhaps to this the advice might be added to beware not to repeat the folly.

In the "Natural History of the Animal Kingdom," for the use of young people, as adapted from the German of Prof. von Schubert, by Mr. W. F. Kirby, there are no such absolute blunders as are to be met with in Goldsmith's work; its shortcomings are more in the direction of omissions and lack of explanation of technical terms. If the adapter had handed say the first part, "On Mammals," to some young and fairly intelligent youth, and then examined him about what he read, he would probably have been astonished at the result; he tried the experiment, the critic perversely turned to the last page, about the "duckbill and spiny anteater," the position of the marsupial bones (nowhere described as having any connection with the pouch) puzzled him, and his ideas fell far from realizing the fact, but when he came to the description of the cavity of the mouth of the duckbill as "a closed weir," his speculations became hopelessly absurd, and we inquired no further. Mr. Kirby, we feel, is not accountable for the illustrations, which may amuse many, possibly instruct some.

The next time the Society makes an attempt in this direction we hope it will succeed better.

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OUR BOOK SHELF.

Commercial Botany of the Nineteenth Century. By John R. Jackson, A.L.S. (London: Cassell and Co., 1890.)

THE general public are so little aware of the sources and history of the many familiar vegetable products which they use daily, that a short description of them in a readable form will naturally be welcome. To provide this is the object of the little book under review: it contains within its 160 pages an epitome of the results achieved by Kew and the colonial gardens in vegetable economics during the present century. The more important attempts to introduce plants of commercial value into new areas, their success or failure, and the consequent effect upon the imports of raw materials, and the prices of manufactured articles are discussed. The facts, in themselves interesting enough, will appeal with additional weight to the reader since they come from head-quarters, the author being the Curator of the Museums in the Royal Gardens at Kew.

Mr. Jackson has wisely avoided the dictionary form, which makes books of this nature so dry and disconnected. He has devoted separate chapters to distinct classes of products, *e.g.* india-rubber, drugs, oils, dyes, fibres, &c., each chapter thus gives a succinct account of the steps taken to advance the interests of a separate industry. Perhaps the most interesting are the pages which describe the rise and progress of the trades in india-rubber (pp. 10-26) and quinine (pp. 60-71); these illustrate admirably the methods pursued by the Directorate of Kew, and it is highly desirable that such statements should be put before the general reading public. It is desirable, not merely for their information in matters which more or less directly concern every one of them, but in order that they may duly appreciate the importance of the work carried on by Kew, in the introduction of economic plants into new areas, and the effect which such experiments have already had upon supply and prices. Mr. Jackson is to be congratulated on having produced a book at once short, interesting, and useful: the facts which he puts forward so closely affect the whole community that they lose little or nothing in weight by the plainness of the style in which the book is written.

F. O. B.

Fresenius's Quantitative Analysis. Translated by Chas. E. Groves, F.R.S. Vol. II., Part 3. (London: J. and A. Churchill.)

THIS third part is especially welcome after the long time that has elapsed since the second was to hand, as we hope it indicates that the rest of the volume is likely to follow without delay. The present part continues the subject of acidimetry, and goes on to alkalimetry, compounds of the alkalies, and alkaline earths (including bleaching powder), aluminium compounds, silicates, and chromium and zinc ores.

The Design of Structures. By S. Auglin, C.E. (London: Charles Griffin and Co., 1891.)

THIS work can be confidently recommended to engineers. The author has wisely chosen to use as little of the higher mathematics as possible in his treatment of the different branches of the subject, and has thus made his work of real use to the practical engineer. It must not be imagined that the author has not thoroughly dealt with his subject. The work is a very good example of the way in which the subject can be adequately treated without the use of abstruse formulæ and complicated calculations. In a volume of 500 pages, we find most of the usual points dealt with, and illustrated by a large number of practical examples such as occur in the every-day experience of the engineer.

The volume is divided into thirty-one chapters, and